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BUTTERFLIES AND MOTHS

IN THEIR CONNECTION WITH

AGRICULTURE AND HORTICULTURE.

A PAPER PREPARED FOR THE

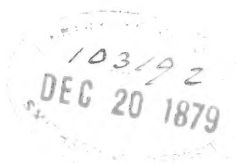
PENNSYLVANIA FRUIT GROWERS' SOCIETY,

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BY

HERMAN STRECKER,

READING, PENNA.



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BUTTERFLIES AND MOTHS OF NORTH AMERICA, IN THEIR RELATION TO HORTICULTURE AND FLORICULTURE.

HERMAN STRECKER, *Reading, Pa.*

That the study of entomology is an absolute necessity to the fruit-grower, the florist, the general gardener, is a fact beyond all cavil, inasmuch as every tree, bush, weed, or flower has its insect depredator, or rather depredators, for they seldom escape with the persecution of one pest alone; and no matter how unsavory, or even deleterious, as many of these may be as food for the higher animals, they are devoured with apparent relish by these rapacious pests, either in the perfect or winged state, or, which is by far more frequent, in the larva, or worm, or grub condition. Nor, as we are well aware, do these grubs, commonly known as caterpillars, worms, or maggots, confine their destructive powers to consuming the foliage of plants, but also attack stems, flowers, fruit, and even in numerous cases bore and burrow into and within the heart of the solid wood of large trees.

What I shall more particularly treat of will be the insects comprised in the great order technically designated the *Lepidoptera*, (from the Greek *lepis*, a scale, and *pteron*, a wing,) but commonly known as butterflies and moths, which comprises by far the greatest number of insects injurious to vegetation. Nor is there, as just alluded to, any plant exempt from their ravages. The bitter sage, the poisonous stramonium, euphorbiae, and solanaceae, the tough, unsavory firs, pine and spruce, thistles and nettles, and even the dry, parchment-like lichens, all furnish palatable food for various species. In fact, there is no plant growing, from the gigantic red-wood trees (*Wellingtonia*) of California, down to the lowly violet, that is exempt from their attacks. Of those feeding in the larval or worm state on the grape alone, are *Procris Americana*, which, when perfect, is a small, narrow-winged black moth, measuring less than an inch across the wings; the *Pandorus* (*Philampelus Pandorus*, Hüb.) and *Achemon Hawk* moths, (*P. Achemon Dru.*;) two large humming-bird moths, expanding across the wing three and a half to four and a quarter inches in different individuals, are both beautiful insects; the first of various tints of dark and light olive green, the second of shades of salmon and rose. Both are produced from huge, naked worms of either green or brownish color, which are among the most voracious of their kind, consuming the leaves in a manner frightful to behold. Allied to these is also the *Myron Hawk* moth, (*Darapsa Myron*, Cram.,) which is, however less in size, being only about two and a half inches across the wings. The front wings and body are olive green, varying in shade in different examples. The hind wings are brick red. The worm which produces this, in addition to eating the leaves, has the abominable habit of eating through the stems of the young bunches of grapes, causing them to fall off.

Abbot's Hawk-moth, (*Thyreus Abbotii*, Swains.,) is about the same size as the preceding, but belongs to a different genus. It has an unusually robust body, terminated by a fan-shaped brush of feathery hairs. The small hind wings are conspicuous for their bright yellow color. The fore wings and body are dark grey and brown, variously shaded and striated. This species is far less common than the three above described. Its worm, like that of the *Philampelus*, is produced of two colors, either brown or green. All

four of these Hawk-moths feed with equal relish also on the Virginia creeper, (*Ampelopsis Quinquefolia*.)

The little eight-spotted day-flying moth, (*Alypia Octomaculata*, Fabr.) is about one and a quarter inches across the wings, of a shining black, with two large round pale yellow spots on each front wing, and two white ones on each hind wing. The worm of this is a little over an inch long, and banded with many black, white, and orange stripes or lines, and spotted with black. At a first glance it has a bluish look, which, on close inspection, proves to be an illusion. Its head is reddish, or rust-colored.

Another allied insect (*Psycomorpha Epimenis*, Dru.) is of somewhat smaller size, black, with a pale yellow band across the front wings, and a bright red one across the hind wings. Its worm somewhat resembles that of the eight-spotted moth just alluded to. Another worm very closely resembles that of the eight-spotted moth, though belonging to the owlet moths, (*Noctuidae*.) and producing an entirely different looking fly. This is upwards of one and three quarter inches, has white upper wings with deep brown border, and yellowish hind wings. It is, in common parlance, called the beautiful wood nymph. Science knows it as *Eudryas Grata*, Fabr. There is a closely allied species, (*Eudryas Unio* Hüb.) also said to feed on the vine; but this fact has never come under my observation, nor am I sure that it is at all well authenticated. My friend, Dr. Pilate, found myriads of the larva feeding on *Epilobium Coloratum*, some miles from Dayton, Ohio.

The common white moth known everywhere as the "Miller," consumes, in the larval state, the grape leaves with avidity. It is the common yellow hairy worm seen everywhere, which feeds on almost any green thing, indiscriminately.

The little leaf-rolling moth, (*Desmia Maculalis*, Westw.) is from a small green worm, that makes for itself a habitation by rolling up a leaf. This little moth is shining black, with two white spots on each front wing, and an irregular double spot on the hind wings. The male has a curious sort of knot about the middle of each feeler or antenna.

The worm of the dainty little feather-wing, or plume moth *Pterophorus Periscelidactylus*, Fitch.) devours the blossoms of the grape, as well as the young leaves, first making a shelter of them by drawing them together with some silken threads. It then takes its repast with more ease of mind than is possessed by the vine-grower on discovering its ravages.

The copper-underwing (*Amphipyra Pyramidoides*, Guen.) is a moth belonging to the Owlets, (or *Noctuidae*.) It is upwards of two inches in expanse, of a dark brownish gray, with bright copper-colored under or hind wings. Its worm is greenish white, with a yellow stripe on each side, and a white one on the back. This worm is not confined to the grape, but will cheerfully take to various varieties of raspberry as well as other plants.

Another allied species, (*Amphipyra Tragopoginis*, L.) found both here and in Europe, also takes kindly to the vine for food. These, my horticultural friends, are the more well known butterfly foes that you are compelled to do battle with in order to save your grapes, both vine and fruit, from destruction.

As I do not intend to more than barely allude to other orders of insects, I will but add that besides these Lepidopterous worms, the poor grape must suffer from the grubs of several beetles, which perforate the leaves, riddling them like a sieve; from a small Hemipterous insect called *Tettigonia Vitis*, or the vine Tettigonia, and the terrible *Phylloxera*, which belongs to the gall insects. So each plant has its enemies, and the more value the plant has the more enemies will appear to assail it. Those alluded to above feed on the leaves, and in one instance on the blossoms. Others, moth grubs,

besides feeding on these, likewise vary their diet by resorting to the fruit itself. Of this class is the well known codling moth, (*Carpocapsa Pomonella*, L.) found in the old as well as the new world, which eats its labyrinthine way through fruit, eventually metamorphosing into a brilliant golden and silvern moth.

The worm of the pretty little green geometrid moth, (*Aplodes Rubivora*, Riley,) eats the fruit of the raspberry; and I should here add yet another Lepidopterous pest, (*Penthina Vitorana*, Pack.) afflicting the grape, which it does by the maggot or larva entering the fruit and domiciling itself therein.

The Cotton-Boll worm, (*Heliothis Armiger* Hüb.) also in some districts called the Corn-worm, is found in most parts of the world. I have examples from many parts of the United States and Territories, from Europe, Liberia, Australia, New Zealand, Chili, Brazil, and Buenos-Ayres. This wretch not only eats, as is too well known, the cotton bolls and young corn in the ear, but also the immature fruit of the tomato, cantaleup, and, without doubt, other fruits in their early stages. This is the species that has been confounded frequently with the true Army worm, (*Leucania Unipuncta*, Harr.) which feeds on grass and grain, and which, likewise, has a wide geographical range, I having received it also, from Brazil, Buenos Ayres, Australia, and New Zealand, as well as from all parts of our own country. The worm of another small moth (*Pempelia Grossulariae*, Pack.) burrows the fruit of the currant. In some genera of moths the worms bore into the stems of plants, or mine the solid trunks of trees; the best known of which, with us, is that producing the pretty steel-blue wasp-like moth, with yellow girdle, (*Sesia Exitiosa*, Say,) which bores the peach trees, entering them at the roots. Another mosquito-looking moth (*Sesia Tipuliformis*, L.) is the product of the worm which bores the currant stems,

Members of the genus of noctuids, called *Gortyna*, bore the stems or stalks of various annual plants. The corn borer, (*Achatodes Zeae*, Harr.) as its name implies, bores the stalks of Indian corn; another species (*Gortyna Nitela*, Guen.) burrows in the stalks of the potato and tomato vines, as well as in those of dahlias and other flowers. The locust and oak are burrowed by a large, tawny, maggot-like worm, the female of which is three inches long, the male scarcely two; this is the larva of the carpenter moth, (*Cossus Robiniae*, Peck,) which bores the solid wood of the tree, in diverse directions, and transforms to a chrysalis within one of the passages thus bored. When ready to emerge, this chrysalis, by means of the serrated edges of its abdominal segments, works itself to the end of the opening, and after the moth has escaped, the empty pupa case may still be seen protruding. The moth is about two inches across the wings in the male, and nearly three in the female; the latter is greyish, with fine net-like lines on the wings, especially on the primaries; the male is distinguished by yellow hind wings. This insect prefers old trees to young; the female lays her eggs in the crevices in the bark. In addition to its infesting the locust and oak, I have found it in an old orchard, emerging from a pound-apple tree. We have several other species of *Cossus*, (*C. Macmurtrei*, Bdl. = *C. Plagiatus*, Wlk., *C. Querciperda*, Fitch, etc.) but these are all very scarce, too much so by far to cause the slightest apprehension of injury. In Europe there are, also, several species, all but two of which (*C. Ligniperda*, F., and *Zeuzera Aesculi*, L.) are great rarities.

But the vast Eucalypti forests of Australia are the true home of this class of insects. There numbers of monstrous species tunnel their way through these trees, the worm of one of which is seven or eight inches in length, and the moth produced from it is nine or ten inches across the fore wings.

The natives of this region, though caring nothing for the destruction of the trees, do not, however, allow the worms to carry out their devices in peace, for by the native gastronome they are considered one of the most desirable delicacies. Mr. Titian Peale related to me, that one day, during a sojourn in Australia, he saw the little native boys acting around the Eucalypti trees in a way which he could not understand. On approaching nearer, and convincing the little fellows that he was not dangerous, they went on with their operations; they had long straws, nibbled near one end into a sort of barb, which they gently insinuated into the openings in the trees made and occupied by the great *Zeuzera* and *Cossus* larva, they then angled away awhile until the disturbed monster seized the straw, when it was gently and dexterously drawn, still holding on to the straw, from its lair, and in a twinkling conveyed to the maw of the young savage, who enjoyed it with the keenest relish. The moths, also, after the wings and hair of the body have been singed off are considered a delectable *bonne bouche*.

But now I must turn from the subject of food plants, as I fear too much space has already been taken up. Let a word suffice to say, that every plant has not only its pest, but its many pests, and many of these, not content to prey on one plant, or even one class of plants, extend their ravages to many. The Aretians, which are hairy caterpillars, in their first stage are polyphagous, eating of almost every vegetable product. The larva of the Io moth (*Hypercheria Io*, Fabr. = *Varia*, Wlk.) will eat willow, corn, cotton, poplar, wild cherry, sassafras, hops, gooseberry, rose, and other plants. The Cecropia moth (*Samia Cecropia*, L.) is also quite a general feeder. The Hickory Horned moth (*Citheronia Regalis*, Fabr.) feeds on walnut, persimmon, rose, and other things, whilst its nearest relative is so particular as to diet, that it will refuse everything except pine, which shows but poorly for its taste. The Lithosians, a genus, or several genera of weak, delicate moths feed, in the grub state, on lichens. But, as a rule, I have found that the vilest, most useless plants were invariably the least afflicted by larval pests, whilst the cabbage is ruined by the larvæ of the Rape Butterfly, (*Pieris Rapæ*, L.) the Zebra moth, (*Cèramica Picta*, Harr.) and others. The strawberry must stand the ravages of its several leaf-rolling moth larvæ (*Anchylopera Fragaria*, Riley, *Lozontaenia Rosaceana*, Harr., *L. Fragariana*, Pack.) as well as of the Dagger moth, (*Acronycta Oblinata*, Ab.—S.) not to speak of the insects of other orders, especially Hymenoptera. The mullen and thistle wax mighty on the highways and road side, and the thorn apple (*Datura Stramonium*) holds undisputed possession, with the ash and garbage heaps, in every neglected out lot, not that they too have not their parasites, but in comparison with the legions that infest useful plants, these are as nothing. Nor are Lepidopterous larvæ confined in their depredations to vegetable productions only. The cloth and fur moths (*Tinea Tapetzella*, *T. Vestianella* and *T. Pelionella*.) subsist entirely in the worm state on the substances, from which they take their names. I might here mention, that the museum pest, (*Anthrenus Museæorum*.) which is such a curse to collections of stuffed birds and animals, dried insects, etc., will also devour woolen goods with as much avidity as its cousin, the dreaded Buffalo bug (*Anthrenus Scrophulariæ*); both of these, however, are grubs of beetles, not of butterflies or moths. It might not be uninteresting to make mention, also, of the fact that caterpillars of various species of the butterfly, probably, more than of the moths, will, from the dearth of their natural vegetable food, attack and devour their own or other species, and the taste thus begotten by necessity becomes so strong that in many instances they will thereafter refuse vegetable food and fall back on the gratification of their cannibal propensities.

There are a few plants that, under the law of retaliation, destroy insects. Of these, *Sarracenia Variolaris*, and Venus' fly-trap, *Dionea Muscipula*, are well known. The insects which are unwary enough to get into the pitcher like leaves of these and allied plants, are held imprisoned by a viscid matter that covers their inner surface. But I would specially mention an insect destroying plant, not as familiar as these, which belongs to the Asclepiad or milk weed family, and is indigenous in some parts of South America. A friend in Georgia has one of them, which he tells me came from Florida, though it may have been originally brought from South America to that State. Its proper name is *Araujia Albens*, (*Physianthus Albens* of some authors,) and it is well known in green-houses here as well as in gardens; it has rather small white flowers, shaped somewhat like those of the common species of milk weed, but not growing in such clusters. To these flowers are attracted a great number of insects of various orders, every one of which meets slow but sure death in the grip of the flower. The moment the small Hymenopter inserts his head he is a prisoner; no struggles will avail to free his head from this floral vise. The thread-like tongue of the butterfly or moth is not slender enough to escape the deadly embrace, and there the unfortunate insect struggles vainly on, held fast by head or tongue, until life is extinct.

Of moths and butterflies that are beneficial but little is to be said. They are beautiful and most interesting objects of study in all their stages, and in all parts of the world. They are attractive even to the unscientific lover of the beautiful, but when it comes down to any actual benefit to be derived from the productions or services of any of them, if we except the few that are used as food, we must fall back on the silk worm of commerce, (*Bombyx Mori*, L.) and its less generally known silk producing congeners. So much has been written and is known in regard to the former that it would be absurd to make any repetitions here; but it is not so well known that several other much larger and gaily ornamented species are also silk producers, from whose cocoons silk is largely obtained and manufactured in India and Japan. Among these are prominent the Cynthia moth (*Attacus Cynthia*, Dru.) the Pernyi, (*Antheraea Pernyi*, Guer.) of China, and the Jama-Mai, (*Antheraea Jama-Mai*, Guerin.) and Ricini, (*Attacus Ricini*, Bdl.) of Japan. The first of these, the Cynthia, has been introduced, and for many years acclimated in New York, Pennsylvania, and Maryland, where it feeds and thrives vigorously on the alanthus; no efforts have been made, at least to any extent in this country, to utilize its silk, though it has, probably, been manufactured for ages in the presidency of Bengal, in India. This silk is coarse, but of exceedingly great durability. The silk of the Mylitta or Tusseh silk worm, (*Antheraea Mylitta*, Guerin.) is also manufactured in Bengal and other districts in India. Our native silk spinners are the Polyphemus, (*Telea Polyphemus*, L.) Luna, (*Actias Luna*, L.) Prometheus, (*Attacus Prometheus*, Dru.) Angulifera, (*Attacus Angulifera*, Wlk.) Cecropia, (*Samia Cecropia*, L.) Columbia, (*Samia Columbia*, S. T. Smith,) Ceanothi, (*Samia Ceanothi*, Behr.) and Glover's silk worms, (*Samia Gloveri*, Streck.) The first four produce compact tight cocoons, the others, especially Cecropia, loose ones. What value these may have commercially is yet to be proven, though Mr. Trouvelot experimented largely with Polyphemus some years ago, but with what success I am unacquainted. They are large showy moths in their perfect state, and Luna, with its long tailed hind wings, delicate pale sea-green color, is the most lovely of all our moths and will compare in beauty with those from any part of the world. Cecropia is our largest species, dark heavily furred, and with reddish bands. It reminds one of the dusky blanketed forms of our own North American Indi-

ans, much as the fanciful speckled wings of the Chinese Agamemnon butterfly, (*Papilio Agamemnon*, L.) engender thoughts of tea chests, porcelain vases, and small footed ladies. The cocoon produced by Glover's silk worm (*Samia Gloveri*, Streck.) resembles arborescent native silver; it is irregular and deeply burrowed, and in color exactly like frosted silver. This species is from Utah, where its larva abounds on gooseberry bushes, both wild and cultivated.

Long years ago, Abbot asserted that the silk of the *Cecropia* moth had "been carded, spun, and made into stockings."—See Naturalists' Library, Vol. VII, Entomology. Before closing my remarks on silk moths, I might as well add, that the larva of one of them (*Attacus Vacuna*, Westw.) is also eaten by the natives along the Ogowai river in Ashanti, (according to a statement accompanied by a figure of the moth in the *Scientific American*, No. 150, page 2394, November, 1878,) which will further extend the small list of species useful to other animals.

The enemies which attack butterflies and moths in the larva or worm state are legion, and among these are man's best friends in the insect world. They are mostly from the orders of Hymenoptera, Hemiptera, and Diptera. The first and last deposit their eggs in the living worm, and when hatched they devour their unwilling foster parent. The Hemiptera, to which belongs man's warmly attached follower, the bed-bug, (*Cimex Lectularius*.) impale the living larva on their sharp beaks, and suck its juices and life out together.

One species of this latter class has been especially useful in lessening the numbers of the worm of the cabbage fly, (*Pieris Rapæ*, L.) A large Ichneumon fly (*Ophion Macrurum*, L.) of a reddish rust color, lays its eggs in the larva of the *Cecropia*, *Polyphemus*, and other species of moths and butterflies. These eggs, when developed, produce a maggot, which eats out the substance of the moth larva. When it is full grown, it makes its own cocoon within the shell of the larva, and in the following spring emerges a perfect wasp-like insect, ready to reenact the same role as its progenitor of the season previous. The Chalcis flies, (*Chalcis Maria* and *Cryptus Nuncius*.) are also parasitic in the larva of *Cecropia* and allies. The Tachina fly, (*Exorista Militaris*, Walsh,) a dipterous or two-winged insect, is another unwelcome guest to the entrails of sundry Lepidopterous larvæ. Size will not exempt them from destructive parasites, for that minute apple pest, the codling moth, is destroyed by two still smaller ichneumon flies, (*Macrocentrus Delicatus*, Cress., and *Pimpla Annulipes*, Br.) whose grubs prey on its larva, as do those of the *Ophion*, etc., on the larger species. Another ichneumon fly (*Pteromalus Puparum*, L.) infests that imported nuisance the oft-mentioned cabbage worm, (*Pieris Rapæ*, L.) This little ichneumon is, in the winged state, a most brilliant golden little fly. *Darapsa Myron*, one of the Hawk moths previously spoken of as feeding on the grape, is frequently infested with the larvæ of a small ichneumon fly. These larvæ, after eating the substance of the worm until they are mature, come out through its skin, and make their small white cocoons on the outside fast to its body, giving it a most novel appearance. Butterflies, moths, and other insects, as well as their larvæ, are infested with the Gordians, commonly known as hair worms, which are the long, white, thread-like worms sometimes seen in puddles, varying in length from four or five inches to two feet. The large species is sometimes found within living butterflies, grasshoppers, crickets, etc., and a small species is not infrequent in the body of the grub of the apple or codling moth. Besides these animal parasitic enemies, and the birds and dragon

flies, vegetable parasites are also found which prey on either the larva or perfect fly.

One species of these affected the silk-worm in Europe to a most disastrous extent. I have had larvæ of the *Polyphemus* moth to die from being affected by a minute fungoid growth. In my possession is an example of a Hawk moth, (*Sphinx*.) in the winged or perfect state, which has a fungus growth issuing from all parts of its body, head, and wings, in filaments varying from a mere point to an inch in length. These issue from the sutures, between the abdominal segments, from the juncture of the wings with the thorax, and between and around the legs, and bristle, porcupine-like, in all directions. I have seen another example. (belonging to Mr. T. Mead, of New York, if I recollect rightly,) also a Hawk moth, but smaller than mine, and not so densely covered with the fungus. Examples of similar growth are exhibited in the figures of Sphingidae, in Cramer's "*Papillons Exotique*," on Plate 267, Figs. A, B. I have also had a beetle from Brazil which had some curious growth, analogous to these here cited, and which, in some places, seemed to have pierced and grown through the hard, horny elytra or wing-cases. Most persons who have paid any attention to economic entomology, will recollect the figures of large beetle grubs, with two long filamentary vegetable growths issuing from the neck, that appeared some years ago in the American Entomologist, and other scientific publications. Whether the growths mentioned above as occurring in the Hawk moths, (*Sphingidae*.) were after the death of the animals or prior thereto, will be, of course, matter for supposition; but that they afflicted the insect whilst alive is not impossible, or even improbable, as Prof. Riley mentions that "according to Dr. Carpenter, it is not at all unusual, in the West Indies, to see wasps, (genus *Polistes*.) flying about with plants of their own length projecting from their bodies;" and we all know of the fungus that attacks the common house fly, glueing it to the window-panes and adjoining wood-work.

The diversity in form and appearance of Lepidopterous larvæ is as amazing, and even more interesting than the wondrous beauty of the perfect fly. The worms of the Swallow-tail butterflies (*Papilio*) are, in some instances, covered with long, fleshy processes, as are those of the splendid Malaysian Priamus butterfly and allies, and our own brilliant blue Philenor butterfly (*Papilio Philenor*, L.) others are of the shape of snails, thickest in the middle and tapering at either end. To this class belongs our graceful Ajax butterfly, (*Papilio Ajax*, L.) Others are swollen near the head, as in the Troilus, (*Papilio Troilus*, L.) which feeds on the sassafras. All of the species belonging to this genus protrude at will, when disturbed, from the neck, a fleshy yellowish or pink Y shaped process, which emits a disagreeable smell.

The worms of the White Butterflies, (*Pieris*, *Colias*, etc.) conspicuous amongst which are the everlasting cabbage pest, (*Pieris Rapæ*.) and the common yellow mud butterfly, always seen congregated in wagon ruts and puddles in country roads, are mostly green and inconspicuous, not easily to be distinguished from the leaves on which they feed. The little blue and copper butterflies (*Lycaenidae*) of our own meadows, are produced from small, oval, apparently footless larvæ. By the way; it is well worth while to mention of these Lycaenid larvæ, that a sweet juice exudes from their bodies, which is greatly sought by ants, who will not injure the worm, but on the contrary take all possible care to do nothing to annoy it. In the pearl spotted butterflies, (*Argynnis*.) the painted lady, (*Pyrameis Cardui*, L.) the Atalanta, (*P. Atalanta*, L.) etc., the caterpillars are covered with long, rigid, sharp spines. The Skippers, (*Hesperiidae*.) a large

family mostly of small butterflies that fly by jerks, hence their name, have smooth, pale worms, tapering at each end, and with thin necks and enormous heads. The Hawk moth worms, (*Sphingidæ*.) among which are the tobacco worm, (*Sphinx Carolina*, L.) the clear wing humming-bird moth, (*Macroglossa Thysbe*, Fabr.) etc., are in most cases known by a long, pointed, somewhat curved horn, on the top of the last joint of the body, which the uninitiated generally mistake for its head. The monstrous and ferocious looking green worm of the hickory horned moth, is furnished with eight large curved horns on the neck, but formidable as this monster seems, it is perfectly harmless, and unable to cause any injury.

Not so, however, with the curious Io moth worms, which feed on corn, willow, cotton, and many other things, and the Maia worms, (*Hemileuca Maia*, Dru.) These are covered with branched processes or spines, which, if the worm be handled, cause excessive pain and redness of the parts of several hours duration. The first of these is pale pea-green, with a narrow red and white stripe along the whole length of each side. The other is yellowish, with red spots on the back and a stripe on each side. To these stinging caterpillars I should add the remarkably shaped footless larvæ of some of the Limacodes, the best known of which is the common saddle-back worm, (*Empretia Stimulea*, Clem.) which every one having rose bushes has at one time or another observed. It is a chunky, square sort of little fellow, an inch long, of a dark chestnut color, with a large pea-green saddle-shaped mark covering the back and sides. In the center of this mark, on the back, is a circular patch of the brown color. This worm has four fleshy horns covered with short bristles, two at each end of the body; and woe betide the one who meddles with these with unprotected hands, or allows them to come anywhere in contact with the bare skin. Phew! nettles are nowhere. Another of these Limacodes larva (*Limacodes Pitheciium*, Ab.-S.) is flat, of a uniform dark-brown color, with four long curved fleshy arms or hooks issuing from each side at right angles. These appendances become detached very easily if the worm be handled, and it contrives to take them off itself before spinning its pupa case, to the outside of which it attaches them as trophies or atrophies. This little worm has a Victor Hugo devil-fish sort of look, but cannot sting, and is perfectly harmless. The small larvæ of the moths of an allied genus (*Lagoa*) look exactly like a close bunch or tuft of wool or raw cotton. Apropos of this subject of stinging caterpillars, I saw a year or two, or more since, in one of the New York weekly story papers, that sports a "science column," a long account of stinging larvæ found in Australia, copied from the proceedings of some scientific society, I believe. This was all so far very well, but unfortunately the editor of this same science department found it necessary to supplement the article with a few original observations of his own, the principal one being a bare-faced assertion that stinging larvæ were so far only found in Australia. Some one should have sent him some of our common saddle-back worms, or those of the Io moth, to convince him practically of the error of his ways. I did drop him a note stating that we had several common species of stinging larvæ in this country, which had long been well known, but no correction of his mistake appeared. I related the incident to friend Fuller, then of the *New York Rural*, who comforted me by exclaiming, "What! do you think a newspaper would correct its own errors? An editor can never make mistakes." We both laughed heartily, for friend Fuller would have been the first to correct his own or anybody else's mistakes as soon as he became aware of their existence; but the above shows badly for that great enlightener of the masses—the popular public press.

In the Harpyiæ, (*Cerura* of American authors,) the extremity of the body is armed with two long horns, each of which encases another horn which the animal darts out when annoyed. Every one is acquainted with the beautiful brush tufted caterpillar, with its bright red head, four short yellow brushes set in the black velvet of its back, and two long feathery tufts at the head, and one at the tail; it is the worm of that nuisance the Tussock moth, (*Orgyia Leucostigma*, Abb.-S.,) whose cocoons, with the white froth-like substance on them that covers the eggs, are found everywhere. The perfect insect is a very inconspicuous thing, the male being a small gray moth, and the female, which is wingless, has much the appearance of an over-fed maggot. Many larvæ resemble, whilst at rest, so closely the substances on which they repose, that their presence will often fail to be detected by the most practiced eye. Among such I might mention the Lappet moths (*Tolype Velleda*, Stoll., *T. Punctistriga*, Wlk.) These, when at rest on the trunk of an apple tree, the leaves of which are their favorite food, so closely resemble in color the bark, that it is almost impossible to discover them. Nor must we allow the curious measuring or span worm (*Phalaenidæ*) to pass unnoticed; these have the habit of holding on to a limb by their anal or last pair of legs, and allowing the body to stand rigidly out at an angle of about fifty-five degrees, and when in this position, further aided by their green or brownish color, the eye may rest on them without a suspicion that they are animate objects. When in motion, owing to the distance between the legs and prolegs being so great, they curve up their body at every step in the form of an arch or horse shoe, hence their name of semi-loops.

Whilst on this subject of the resemblance of larvæ to other objects, commonly though improperly termed mimicry, it might not be amiss to recur to a few instances of this so-called mimicry in the perfect insects, the moths and butterflies. Foremost among these I would name the *Catocalæ*, or underwings. These are mostly large moths, frequenting the trees in our woods, on various kinds of which their larvæ feed. The body and upper wings are grey or brown, variously mottled in darker shades and marks. The lower wings are either bright red, or yellow with black bands, or else entirely black; and one exceptional species in this country has the hind wings black, with a white cross-band. When at rest the grey or brown upper wings entirely cover and conceal the conspicuous-colored underwings, and when the insect is in this position on the trunk of a tree, which is its general resting place, it assimilates so closely in appearance to the bark and the lichens growing thereon, that it is detected with difficulty, even when searched for; and what is still more curious, is that the paler species appear always to rest on bark of some analogous color, and the darker ones on that simulating their color. One species (*Catocala Cara*, Guen.,) has the upper wings of a far deeper shade than in most of the other species, appearing, at a casual glance, to be almost black; and, strange to relate, in a piece of woods where I was collecting on one occasion, all the examples of this species which I found were clustered on some huge black warty excrescences on an old tree, the color of which was nearly the same dingy hue as the wings of the insect. This is no isolated instance, but the rule, not the exception. It is this resemblance to lichen, etc., that has caused them to be called in France *Lichnées*, as *Lichnée Bleue*, for the blue-banded underwing; *Lichnée Jaune*, for the yellow, and so on.

Another moth, belonging to a different family, known as the American Lappet moth, (*Gastropacha Americana*, Harr.) when at rest precisely resembles, both in shape and color, a dead leaf; hence the name of *Feuille-Morte*, given to an allied species, (*Gastropacha Quercifolia*, L.)

Other Lepidopterous insects resemble wasps and bees; the moths of the peach, currant, and other borers, (*Sesiidæ*), are complete counterfeits of Hymenopterous insects, excepting that they are powerless to sting.

The clear-winged Hawk moths (*Macroglossa Diffinis*, Bdl., *Axillaris*, G.—R., *Æthra*, Streck., etc.) are the counterparts of large bees, their bodies being thick, short, and covered with black and yellow hair, and their wings, excepting the narrow outer margin, are devoid of scales, and are clear as glass, which makes the deception complete. From this resemblance, one of the common European species is known as *M. Bombyliiformis*, or the bee-shaped Hawk moth. What still further aids the deception is that all these bee and wasp resembling moths fly in daylight, not during the night, as do the vast majority of moths. A class of true day butterflies, common to tropical America, belonging to the genus *Ithomia*, also have the wings nearly devoid of the colored scales, and, consequently, are quite transparent; this, in addition to their slender, needle-like bodies, gives them considerable resemblance to dragon flies and other neuropterous insects. Not the least curious instance of involuntary mimicry is the remarkable resemblance which some butterflies and moths bear to others of entirely and widely distinct genera, or even families. In our own country we have an instance in the common reddish Misippus butterfly, (*Limenitis Misippus*, L.) which is the close counterpart in shape, size, color, and markings to another common species, the Plexippus, (*Danaïs Plexippus*, L.) which belongs to the Danaidæ, a family widely separated from the first, which is one of the Nymphalidæ. In Florida and other southern States is another species of Danaïs called Berenice, (*Danaïs Berenice*, Cr.) which is dark brown, instead of the bright rust red of the more wide-spread Plexippus. Now the first mentioned species, Misippus, likewise occurs in the same localities as Berenice, but, curious to relate, instead of being of the bright red color that is one of the leading features in its resemblance to Plexippus, it is in these southern examples of the same deep brown as Berenice. This Misippus butterfly, I should add, is the only one of its genus that is red, the typical colors being black or dark brown, with a white band crossing the wings, whilst the species of that group of Danaïdæ to which Plexippus and Berenice belongs are of reddish rust color, of darker or lighter shades.

In connection with the preceding, I will mention the more curious, though analogous, case of the Chrysippus, (*Danaïs Chrysippus*, L.) which occurs in most parts of Africa, Asia, the Pacific islands, as well as in south-eastern Europe. This is, in its ordinary form, of a paler red than our Plexippus, more inclined to yellowish; otherwise marked much in the same way. In Senegal there is a variety of it with white hind wings, (*Danaïs v. Alcippus*, Cr.) and in Syria and Abyssinia is an aberrant form, in which the white spots contained in the black patch near the points of the front wings, in the common form, is wanting. This variety is known as the Dorippus. (*Danaïs v. Dorippus*, Klug.)

There is a genus of beautiful butterflies in the family of Nymphalidæ, called Diadema, whose colors are black, with bluish shades or patches, and in the shape of the wings it is fuller and rounder in outline than the aforesaid Danaïs butterflies; but now mark: the female, and that sex only, of one single species of these, (*Diadema Bolina*, L.) departs entirely from the normal black and blue forms to such an extent as to resemble so closely the yellowish red Chrysippus, not only in color and ornamentation, but even in shape, as to be almost undistinguishable from it. But, further, this female Diadema, when occurring in Senegal, sometimes varies in having the hind wings whitish, like the variety of Chrysippus previously alluded

to from that country under the name of *Alcippus*. Again, in other instances it is found entirely without the white spots and black patch of front wings, thus becoming an exact imitation of the other variety *Dorippus*. All the males of the butterflies of the genus *Danais* have, on the second median nervule or vein of the hind wings, a small, hard, black knot-like spot, which is a sexual distinction, the females being entirely without it. So, to make the imitation still more nearly perfect, in the female of the *Bolina* butterfly there also are no traces of any such spot. So close is, in fact, the outward resemblance between these generically widely different insects, that the old authors figured and described them as one and the same. Nor have I yet done with this marvelous freak and its adjuncts, for, "like the circle that ever returneth in to the selfsame spot," it has led us back to the starting-point of this topic, the *Misippus* butterfly; for in this also occurs a variety in which the white and black spots and marks near the apices of the front wings are entirely gone, thus keeping up the same form exhibited by the varieties of the other widely different insects *Chrysippus* and *Bolina*. I might go still further, for in the green-colored butterflies of the African genus *Romaleosoma* there is another of those red mimics. But I will cease, for the subject is a vast one, and as yet a mystery profound, even to science, which is utterly at a loss as to what are the causes. No one would imagine that these are the wild freaks of chance. Nature is methodical. Her law, like that of Heaven, is order. Everything is done in beautiful harmony. That this resemblance in these instances is for protection, as is strongly advocated, I do not believe.

The species of *Danais* butterflies that are mimicked are nauseous and unpalatable to birds and predatory insects, and thus enjoy perfect immunity from such foes. It has on this account been reasoned that the *Misippus*, which resembles them, enjoys like immunity, on account of its livery being like theirs, and so totally unlike that of all its relations. This, however, is without a particle of foundation, beyond that existing in the imagination of its originators. The other species of *Limenitis* butterflies, (the genus to which *Misippus* belongs,) are just as common, sometimes more so where circumstances and surroundings are favorable. In the wilds of Luzerne county, Pennsylvania, I saw, probably, one hundred of the *Arthemis*, (a species belonging to the same genus,) to every one of the *Misippus*, and it was not for want of foes that either escaped, for the dense forest was alive with birds, and the lace-like wings of the dragon-flies, (*Aeschna*, *Agrion*, etc.) glistened as they darted here and there, or hovered in mid-air over the pools and trout streams. In our neighborhood, near Reading, another species, *Ephestion*, (*Limenitis Ephestion*, Stoll,) which is black and blue, is found in about equal numbers with *Misippus*. In some localities, more westward, the first is commoner than the last named species. In South America the glades in the forests swarm with certain long narrow-winged bright-colored butterflies, belonging to various genera in the *Danaidæ* and *Heliconidæ*, which birds will not eat owing to their disagreeable taste and smell. These have analogues in appearance, which, for convenience sake we will call mimics, in several other families, especially among the *Pieridæ*, or white butterflies, and in the *Melitææ*, a genus of small butterflies, the normal forms of which have wings of a reddish or tawney color, marked with black. Now the genus of the *Pieridæ*, which mimics the narrow winged unpalatable *Heliconidæ*, and which technically is known by the name of *Leptalis*, contains just about the scarcest of all the butterflies in that family, and the nearer they approach the *Heliconidæ* in appearance, the scarcer they are in nearly all cases; and the commonest of all are just the ones which recede furthest from the *Heliconidæ* and approach nearest

to the typical broad winged, white *Pieris* butterflies. Any one who has collected exotic butterflies will bear me out in this statement as to the extreme rarity of the species of *Leptalis*.

In every collection coming from Central or South America, will be found great numbers of common forms of white and yellow *Pieridæ*, but seldom indeed more than a few, if any, of the aberrant *Leptaliid* forms which resemble so closely the *Danaidæ* and *Heliconidæ*. But I have digressed, and must return to the matter more directly under consideration. The resemblance of butterflies to other objects, is not confined to the perfect insect, or even to the larva or caterpillar only, but also to the chrysalids and cocoons, or pupa cases, which they construct. All collectors know how difficult it is to detect the cocoons of the larger moths, *Cecropia*, *Promethæa*, etc., from the dead leaves that surround them. And to every one is also known the curious sack which contains the worm, then the chrysalis, and lastly the eggs of the moth, commonly known as the bag worm, or drop worm, (*Thyridopteryx Ephemeraeformis*, Steph.) This is formed of silk by the worm, and covered with bits of leaves and stems of whatever particular tree it has favored. For this species is a general feeder, attacking anything from a gooseberry bush to a pine tree. The male only is winged, and its wings being transparent and narrow, it resembles some bee or fly more than a moth. The female receives her mate without leaving the sack in which she afterwards deposits her eggs, and then only for the first and last time during her existence, does she quit it to fall to the ground and die. In some exotic species, the female remains in the sack after she has laid all her eggs, and dying there, becomes the first food the young larva consumes after emerging from the egg. Most of these insects are embraced in the two genera, *Oiketicus* and *Psyche*. Ours and those of Europe are very pigmies aside of some from the tropics, for instance the *Oiketicus Saundersii*, of Westwood, from Australia, the female of which forms a sack seven inches long.

One species in Tyrol, in which both sexes are winged, (*Typhonia Lugubris*.) forms its sack with grains of sand, in the form of a long cyndrical tube. Most curious of all, composed of like material, in the form of a snail shell, is the pupa case of *Psyche Helix*, figured in Siebold's *Parthenogenesis*. So deceptive is the appearance of this and allied species that one kind, found in the Atlantic States, from Nova Scotia southwards, which is presumably of some species of *Psyche*, was actually described, by the conchologist Lea, as a shell, under the name of *Valvata Arenifera*.

Of insect architecture, which is partly embraced in the foregoing, I have not space to add much more than to allude to the enormous webs, sometimes nine or ten inches in diameter, spun by colonies of worms, the larvæ of the Lacquey moth, (*Clisiocampa Americana*, Harr.) on our fruit trees. From the hole in this web tent emerge the throng of worms in military order, twice daily, (morning and afternoon,) to feed on the surrounding foliage; on rainy days they remain indoors, and do not feed. When full-grown, they break up house-keeping, and disperse, each one going its way in search of some suitable place to spin its cocoon. These worms are a great nuisance, but as they live in company, in their large, conspicuous tents on the trees until mature, they are easily destroyed. Another allied species (*Clisiocampa Sylvatica*, Harr.) lives on our forest trees.

Whilst on the subject of mimicry in butterflies, I had intended to make some reference to monstrosities, and will devote some space to the same. It sometimes happens that from a brood of caterpillars, emerged from a batch of eggs laid by one female, there will in due time be among the butterflies therefrom produced one that differs in coloration and marking—

sometimes even in shape—from all the others of the same brood. These freaks or aberrations are sometimes far handsomer than the normal form, and always of great interest, as we can have so little idea of the causes producing them. In most cases they are unique, and remain so, but more seldom they are repeated, turning up again at long intervals. The common painted lady butterfly (*Pyrameis Cardui*, L.) occurs sometimes with the underside of the wings almost wholly white, and the upper side with the red-ground color crowding out the black to a large extent. In others it is just the reverse, the black obscuring most of the wings on both surfaces. Of this black form I know of two examples, one in Europe and one in my own collection. Trimen also mentions examples taken at the Cape of Good Hope. Of the first, or white aberration, besides Rambur's type, and the original of Herrich-Schäffer's figures, I am aware of the existence of five—one in Europe and four here. Of the latter, I have the good fortune to possess one; and there was a curious coincidence in my obtaining it. A few weeks since I was at the Academy of Natural Sciences, of Philadelphia. Whilst there I noticed on a table a number of books and pamphlets, lately received, among them a late number of the *Annales Société Entomologique Belgique*. In turning over its leaves, I lighted on a plate with five figures, the upper two resembling the black form alluded to, and the next the white aberration, taken from examples recently captured. I closed the book with a despondent feeling. There, I thought, some one else has had the luck to get that wonderful thing; I don't suppose I'll ever be so fortunate. The day had been cold, and drizzling rain kept up unceasingly. I had a wretched cold myself, and as the shades of evening came on I debated whether I should spend the evening with my friend Blake, curator of entomology at the academy, or creep into the dreary confines of a hotel room and snooze off the blues. Still debating the matter, I listlessly walked on in the direction of my friend's domicile, and at last as listlessly reached it, where warm welcome and friendly faces banished the blues and my weariness. "By the way," said my friend, "I got, from so and so, a pale *Cardui*. He caught it down near the sand-pit, and had it pinned in one of his butterfly pictures." "I suppose it is faded from being hung up in the picture, not so?" I responded. "You will see it after supper," he said. There it rested. An hour or two later, in looking over his collection, when the box containing the Vanessians was opened, lo and behold there, pinned, reverse side up, was the counterpart in nature of the picture I had seen a few hours before at the academy. I thought of clairvoyance, of second sight, and of more things than are dreamed of in our philosophy. To end the story, my old friend, with his usual good heartedness, presented me with the wonderful insect, which now is one of the choicest adornments of my cabinet.

Some monstrosities have the marks of the wings of one side different from those of the other. I have seen an example of the Utah silk worm moth (*Samia Gloveri*, Streck.) a species allied to our *Cecropia*, which had the left wings of the normal dark red color, whilst those on the right were entirely white. I have given a figure of this curious sport on Plate 14 of the indigenous and exotic Lepidoptera. Others occur which are entirely albinous. I received not long since, from Germany, an example of *Epinephile Hispulla*, Hüb., a butterfly that, normally, is dark brown, which was an albino, having all the marks of the ordinary form faintly defined; but the brown ground color, peculiar to the whole insect, was replaced by yellowish white. Of our common yellow mud butterfly, I have examples that are entirely black. These, of course, are only freaks, and do not reproduce their kind; but other aberrations have become, through change of climate, food, or other causes but imperfectly known, to all purposes, species, pro-

ducing their kind from season to season. Thus the Cynthia silk worm, acclimated with us many years, is no longer the Cynthia of China, its original progenitor. The strongly falcate narrow wings of the Asiatic type of Attaci is replaced by the broad rounded form of those of North America, as in *Cecropia* and *Angulifera*.

The great tiger moth (*Arctia Caja*, L.) has, in North America, a white collar. In European examples, this adornment is only occasional, being the exception, not the rule; but both American and European examples have orange colored hind wings. In Asia Minor, (Amasia and Tokat,) the female only has the orange hind wings; in the male they are pure white. In British Columbia, the common swallow tail butterfly (*Papilio Turnus*, L.) is small, and the female is always the same yellow color as the male. In Pennsylvania, and southwards, it is a dimorphic species, having two forms of females; one yellow like the male, the other entirely black. So I might go on; but this is enough to illustrate the subject.

Among the butterflies true hermaphrodites occur, at least as far as all outward signs exhibit. In my possession is an example of the common dimorphic swallow-tailed butterfly just mentioned, in which the right side of the body and two right wings are yellow and male, and the left half of the body and left wings are black female. The division of the sexes is perfect, in this example, even to the anal valve on the male side.

Another instance is of the *Promethea* moth, (*Attacus Promethea*, Dru.) in which the right wings and right half of the body, the head, and both antennae, or feelers, are male, and the left half of the body and both left wings are female. I have also an example of the Io moth, (*Hypercheria Io*, Fab.) which is still more curious; the body, the left antenna, the left upper wing, and both right and left hind wings, are male; whilst the right antenna, a small patch on the right side of thorax, and three fourths of the right upper wing, are female, and the one fourth, along its inner edge, is also male. This sexually was doubtless male, as it was captured whilst endeavoring to copulate with a female which had newly emerged from the chrysalis in a friend's house, in Hudson City, New Jersey. Of this mixed up sort of hermaphroditism, I have also two examples of the Philenor butterfly, (*Papilio Philenor*, L.) in which parts of three wings are male, and part female. An example of the *Promethea* moth of this kind is recorded in the fourth volume of the Proceedings of the Entomological Society of Philadelphia.

An example of the Castor butterfly, (*Papilio Castor*, West.) is figured and described in the Wiener Entomologische Monatschrift, in which there is the same utter confusion of sexes. Others are recorded, and in various collections, but I have cited enough to give some fair idea of this species of abnormality, though I will yet add that there is another form, known to have occurred in some Hymenopterous insects, though never so far in butterflies or moths. It is where the thorax, head, and front wings are of one sex, and the abdomen and hind wings of the other.

Another curious monstrosity has occurred in the female of the common swallow-tail butterfly, (*Papilio Turnus*, L.) This species, as I have mentioned, has two kinds of females—one black and one yellow. In the example I now allude to, the two wings on one side, and half the body towards the same, are yellow, and the other half of the body and two wings are black. At first appearance it looked like the hermaphrodite previously described, but closer examination showed it to be a blending of the two forms of one sex. Those persons who have one eye blue and the other brown are, I suppose, somewhat analogous examples in the higher animals, though

if one existed which was longitudinally divided into blonde and brunette half and half, it would be a better illustration still.

Another form of monstrosity is that produced by the pairing of the male of one species with the female of another. The offspring of such illicit intercourse partakes of the character of both parents, most curiously and beautifully blended. A very curious thing in regard to these hybrids, emanate they from what species they may, is that they are invariably of the male sex. I never saw or knew of any of the other sex being recorded as having occurred. Nor is the production of hybrids of sufficient rarity to cause the surmise that we know of too few examples to base such a belief upon, as of several species in Europe they have been produced in confinement by the hundred, as in the case of the pairing of the eyed willow Hawk-moth (*Smerinthus Ocellatus*, L.) with the poplar Hawk-moth, (*S. Populi*, L.) Whether bastards are able to aid in the reproduction of species by coupling with examples of the species of either parent, I am unable to say, but doubt very much if they can.

Having now treated of variations, etc., it might not be amiss to say something in regard to the geographical distribution of species and their bearing to each other, in the different parts of the world, as well as express some ideas in regard to the belief that they are all but the emanations from some one original form, existing many millions of years since; as I am no believer in the especial creation of each species, which doctrine is directly disproved by the fossil butterflies, of which, as far as have been discovered, not one is of any species now known to exist. Moreover, a careful study of the moths and butterflies of different parts of the world will show how wondrously they are linked together, not only in a continuous line, but interlinking, as the rings in a coat of chain armor, and that, too, by species and genera in countries as widely remote from each other as Buenos Ayres and Australia. The forms found in some genera or groups seem none of them to have yet died out, as for instance in some groups of the Asiatic genus *Euplaea*, in which no man can tell which are species or which varieties, one has only the choice of designating the whole group as one species, or of making a species of every individual example.

But now to speak of the geographical distribution. The butterflies of Labrador, British Columbia, that part of the United States and Territories on the Pacific side of the Rocky Mountains, Persia, Siberia, Europe and northern Africa, (Algiers, Morocco, Tunis, and Egypt,) are in a great measure analogous, and in some instances species are identical. The Antilles, Mexico, Central America, and South America, exclusive of Chili, Buenos Ayres, and Patagonia, have a fauna of their own, wonderful for its diversity and glorious beauty, and they are the richest sections in the whole world in these insects. Many more species may be taken within a circuit of forty miles near Para than are found in all Europe. India, the southern half of China, and the Malaysian and Australasian islands have another and distinct fauna, also great in numbers of species, remarkable for strange form and splendid coloring. In Australia, in this as in the other animals, there is a tendency to some departure from the forms of the neighboring islands. Africa, excepting Egypt and adjacent parts, and those parts north of the Great Desert, has its own peculiar fauna, to which that of the neighboring great island of Madagascar assimilates. Of Thibet and Central Asia we as yet know next to nothing.

Now, having taken a cursory view of the disposition of the Lepidopterous fauna in most parts of the world, including our own western coast, we will direct our study to that of the portion of the United States east of the Rocky Mountains, which we will find, in many instances, partaking of the

character of those from most other countries. The nearest analogue to the great bird-wing butterflies, (*Ornithoptera Priamus*, etc.), of Malaysia and Australasia, is found in our *Philenor* butterfly. Our *Troilus* butterfly is also nearly allied to Asiatic species, but not to any one in the new world. With the exception of *Phaeton* and *Harrisii* (*Melitaea Phaeton*, Dru., and *M. Harrisii*, Scud.), the analogues of our *Melitaea*, (*Eresia* of some authors,) a class of little orange or rust colored butterflies, are to be searched for in Brazil, and other parts of tropical America; whilst the species of the same genus, west of the Rocky Mountains, are the closest allies to European and Siberian species. The species nearest to our only two Aurora butterflies (*Anthocharis Genutia*, Fab. et *A. Olympia*, Edw.), are one (*A. Scolymus*, Butl.) in Japan, and the other (*Zegris Eupheme*, Esp., etc.) in South Russia and Turan. Of the two species of *Colias* we possess, the common yellow butterfly, found sitting near puddles and in wagon ruts, is, without doubt, a modification of the sub-polar *Pelidne* butterfly (*Colias Pelidne*, Bdl.) Of the curious long-snouted Libytheidae we have our share, three being at home here. These are, however, doubtless all forms of one species; besides these, there are ten others—one in Cuba, two in Hindostan, one in Ceylon, three in the Malaysian Islands, one in Europe, and two in Africa. The nearest species to our superb Diana butterfly (*Argynnis Diana*, Cram.) is found in the Chinese Sagana, (*Argynnis Sagana*, Dbl. & Hew.) Our *Semideia* butterfly, found only on the summit of Mount Washington, in New Hampshire, has its true home in north-western Labrador.

Now, turning from the day butterflies to the moths, we find that our peerless Luna moth (*Actias Luna*, L.) belongs to a genus whose other members are found only in India and Africa. For the nearest kin to our *Promethea*, *Polyphemus*, and other large silk spinners, we must also look to Asia and Africa. Of the underwing moths, (*Catocala*,) the United States and Territories have more than double the number found in all the other parts of the world together. In Arizona, as far as the comparatively small portion of species known will allow us to judge, is exhibited in a large number of species a tendency to pale or albinous forms, the most remarkable of which is the *Alma* butterfly, (*Melitaea Alma*, Streek.) which is an albino analogue, or variety, perhaps, of the Californian *Leanira* butterfly, (*M. Leanira*, Bdl.) and *Sphinx Elsa*, a Hawk moth, which is a white representative of our more eastern Plum Hawk moth, (*Sphinx Drupiferarum*, Abb.-S.) also, the wonderful white female of the *Nokomis* butterfly, (*Argynnis Nokomis*, Edw.) a probable variety of our *Cybele* butterfly, (*A. Cybele*, Fabr.) That the saltiness and dryness of the arid regions producing them accounts in some measure for the prevalence of these pale abnormal forms, is in the highest degree probable.

Some few species common to the United States are also perfect cosmopolites. The "painted lady" butterfly (*Pyrameis Cardui*, L.) is found in every part of the world. The *Antiopa* (*Vanessa Antiopa*, L.) is common to all parts of North America except the extreme north or polar regions, and is also found all over Europe, and in Siberia and Japan. *Leucania Unipuncta*, the "army worm," is also found in many parts of the world. The *Plexippus* butterfly (*Danaus Plexippus*, L.) has been within a few years introduced, by easy stages doubtless, from our own country to Australia, where it is as common now as with us; the chrysalis, or even the perfect fly, for it is hardy, doubtless was through commerce carried from San Francisco to some point not far distant in the Pacific, and from thence further, and so on until Australia was reached.

Of species introduced from abroad, and now thoroughly acclimated here, we have the White Cabbage fly, so often and unfavorably spoken of, the

Currant borer, (*Sesia Tipuliformis*), and the Cynthia moth. As yet, no example of any fossil butterfly has been found in the New World, though many of other orders (*Hymenoptera*, *Diptera*, etc.) abound in the shale of Colorado. All the Fossil Lepidoptera known, about a dozen examples, are from Europe; five from Aix, in Provence, in France; four from Radoboj, in Croatia, one from Germany, and three from England. (On these last, some doubt has been thrown as to their being butterflies at all.) As far as I can determine from figures and descriptions, one of them (*Vanessa Atava*, Charp.) is of the same genus as several that occur in the United States, (such as *Vanessa Californica*, Bdl., *V. Van-album*, W. V., etc.) And three others, (*Pierites Freyeri*, Heer, *Thanatites Vetula*, Heyden, and *Pamphilites Abdita*, Scud.) belong to supposed extinct genera, allied to the existing *Pieris*, *Nisoniades*, and *Pamphila*, all largely, and the last two principally found in the United States; two of the others, (*Cylo Sepulta*, Bdl., and *Lethites Reynesii*, Scud.) are apparently allied to our Portlandia butterfly, (*Debis Portlandia*, Fabr.) all the other representatives of whose genus are Asiatic. Of the remaining species, all belong to genera which have no living representative. The one described by Heer as *Thaïtes Ruminiana*, I consider the most interesting. It appears to be, as Scudder suggests, (in Proc. American Association I, pages 57-62, Plate III, Figures 1, 3, 6, 7, 8, 9, 10,) allied somewhat to the modern genera *Thais* and *Parnassius*, but I fear the figure of the restoration (Figs. 3, 2, c.) was founded as much on a knowledge of species of those genera, as on the fossil itself. Without there being any similarity worth noticing in detail, this same restoration reminds me forcibly of *Doritis Appolinus*, Hbst., a butterfly belonging to, and comprising a genus allied to *Thais* and *Parnassius* mentioned.

From what I have stated here, as well as elsewhere in this paper, it will be seen how necessary it is for the student, in endeavouring to attain some fair knowledge of the study, to devote attention to the species from other countries as well as from our own, for all are but links in one continuous chain, and many apparently inexplicable points become clearly explained by a knowledge of the genera and species comprising the faunæ of other lands; for nature has set no township or county lines in these matters. All are but integral parts of one great system. I do not by this advise any one to undertake the frightful task of making a collection of butterflies from all parts of this earth; but time devoted to the study of such authors as Westwood, Hewitson, Felder, Boisduval, and others, will not be misapplied; but, of course, a fair acquaintance with our own species should first engage the attention. One of the earliest books treating solely on butterflies and moths of North America, was that of Abbot and Smith, on the Lepidoptera of Georgia, published in 1797, in two large volumes, with one hundred and four colored plates, representing the insects in all their stages. Boisduval and Le Conte published the next principal work, the *Histoire generale et iconographie*, etc., in 1833, with seventy-eight colored plates; this is in French. Thomas Say, of Philadelphia, published three volumes of his *American Entomology* in 1824-1828, with fifty-four colored plates of insects of various orders.

Dr. Harris, in 1841, published his report on the insects injurious to vegetation. Subsequently revised, enlarged editions were issued in 1842, 1852, and 1862. This work is standard, and too much cannot be said in its favor. The last edition (of 1862) is profusely illustrated with plain and colored plates of North American insects of all orders. Besides this, Dr. Harris wrote large numbers of articles on economic entomology for the various agricultural and scientific periodicals and journals of the day.

In 1862 the Smithsonian Institution published a synopsis of all the then known butterflies and moths, as far as the end of the Bombycidae, or Spinners, which was compiled by the Rev. John G. Morris, D. D., of Baltimore. Though many scores of species have since been discovered and described, this book can still be consulted with advantage to the student, as it contains short descriptions of all the species cited.

Prominent among those of the present time who have devoted themselves largely to the subject, especially in its relation to agriculture, is Prof. Townsend Glover, late Entomologist of the Agricultural Department, from which position he has at length been forced to retire, utterly broken down in health, the disastrous result of years of untiring, incessant, self-abnegating labor in this branch of science. Some slight idea of this man's wonderful industry and perseverance may be formed from the fact that in default of the patronage that should have been given him by the Government he so long and faithfully served, he published small editions of five of his works for private distribution, in which not only were all the copperplates that illustrate them the work of his own hands, but the voluminous accompanying text was also lithographed by himself, after his official hours, in the time that others devote to rest and recreation. These works are, however, but a tithe of his labors, as besides the many agricultural reports, an immense amount of his manuscript is yet unpublished, which, unless the Government takes some measures, I much fear will be lost to science. The extent of Prof. Glover's labors are yet to be estimated at their true value.

Prof. C. V. Riley, his successor in office, has contributed largely to the knowledge of economic and scientific entomology. The "American Entomologist and Botanist," which was first published in conjunction with the late Benjamin D. Walsh, and latterly by himself solely, cannot be spoken of in terms sufficiently commendatory. It should, in fact, be in everybody's hand. His various reports on the noxious and beneficial insects of Missouri, issued whilst he was official entomologist to that State, are invaluable. His discoveries in regard to the grape pest, the Phylloxera, secured him the honor of a gold medal, especially struck for the purpose, from the government of France.

Dr. Asa Fitch, when State entomologist of New York, issued reports on the noxious, beneficial, and other insects of that State, during the years from 1855 to 1870, excepting only 1868. These contain a large amount of interesting matter, the result of careful, laborious study, but they are long out of print, and, unfortunately, exceedingly difficult to obtain.

Prof. J. A. Lintner, of Albany, New York, has done much truthful, conscientious work in his entomological contributions in the annual reports of the New York State Museum of Natural History.

Dr. A. S. Packard's noble work on the geometrid moths of North America was issued under the auspices of the Government. The same author also issued, some years ago, a "Guide to the Study of Insects, but unfortunately it is entirely too scientific to be of any use whatever to anyone but the advanced student, who don't need it at all.

A. S. Fuller, of Ridgewood, New Jersey, formerly connected with *Moore's Rural New Yorker*, and Prof. S. S. Rathvon, of the *Lancaster Farmer*, are so well known to you all, and have both contributed so largely to entomological and agricultural literature, both popular and scientific, that more than the mention of their names would be superfluous.

W. W. Saunders, the editor of the *Canadian Entomologist*, has contributed to a great extent to the knowledge of the transformation, habits, etc., of North American insects. Most of his articles are contained in the aforesaid periodical, of which he has long been editor in chief.

In the bibliography of my lately issued text-book on North American butterflies and moths, I have endeavored to give a full list of the writings of all these authors mentioned, as well as of all others who have written on North American butterflies.

Now, doubtless, you not only think it is time to make the beginning of the end, but even to make the end. That more attention is not given in this country to directing the youth to the study of nature in its various branches cannot be sufficiently deplored. In Europe every school boy has his herbal, or his collection of birds eggs, or of insects, or minerals, as the case may be, here most school boys waste their golden hours in bat and ball, in idleness and thoughtlessness, utterly ignorant that the only true mode of recreation lies in the change of occupation. Certainly it is far more instructive, surely as healthful, and produces far better results, to go into the fields and woods, where every leaf, worm, fly, aye even the stones we tread on, furnish matter for wonderment and admiration. Neither in pursuing such a course will ensue any of the evil effects most always the result of the so called healthful games, such as the loss of an eye, of front teeth, a broken arm, and permanently distorted or crippled fingers. It is true, there has been little encouragement for these field and forest studies, for it has only been within a very few years that the collecting of insects or "bugs" has not been considered in this country as *prima facie* evidence of a disordered intellect, and the few votaries of entomology were obliged to keep their collecting implements out of sight until the freedom of the woods was obtained.

I recollect some ten or twelve years ago, one Sunday, whilst collecting in a neglected field, near Bernhard's dam, that the proprietor of the ground, or of some neighboring territory, a pleasant, hale old gentleman, came down in his shirt sleeves to gratify his curiosity in regard to my doings. He first approached with the proper caution due to nearing an equivocal animal, but assuring himself by the placidity of my countenance, doubtless, that there was no apparent danger to be dreaded, he approached me, and in the Pennsylvania German dialect asked what I was doing. I showed him my collecting box and its contents, my net, etc., and as at the moment a large female of the *Ephestion* butterfly flew near, I joined example to precept by capturing and killing and pinning it in my collecting box in his presence. The most difficult part to make the old gentleman comprehend, was what the things could be used for after they were caught. I attempted an explanation. Whether I was successful in doing so to his satisfaction I still doubt. However, he seemed pleased, and by way of explanation said, as he departed: "Ich haab dich gasayn for ein bar Suntaag here und durt so rum springe un ich hab gaydenkt du waarst so ein Kaerl wo nicht gons recht in kopf war, aber."* Here he paused and looked puzzled, and I fear to this day the worthy old husbandman, (bless his kindly face,) is still, if living, in a state of suspense as regards my being responsible for my actions before the Lord and my fellow-man.

Later, however, since it has become more generally known that these things will actually sell for money, the discerning eye of the public looks with considerably more leniency on the "bug hunter." In one instance a couple of years since, even such a distinguished functionary as a Florida judge graciously vouchsafed to turn the energies of his great brain matter in that direction, though in the case of so exalted a personage, it, of course, was by proxy he deciding like the bald eagle that feeds at the

* "I have seen you running around here and there for the last couple of Sundays, and I thought you was one of those fellows who were not quite right in the upper story, but"

expense of the fish-hawk which catches the prey, to remunerate himself by the labors of others, by seizing the persons of two collectors from Michigan, Messrs. Hubbard and Schwarz, and incarcerating them in the county jail as breakers of some local law that no game should be taken out of the State.

This embodiment of legal acumen hinted, that as he was a feeling man, the matter might be satisfactorily adjusted for the moderate sum of fifty dollars, which these two gentlemen did not pay, but after one night spent in "durance vile," managed to obtain their freedom through the influence of some one in power, with a less fully developed bump of acquisitiveness than the worthy judge, who after all only followed out the instincts of his nature, as do most other animals. May the earth rest lightly on him hereafter.

Good friends, if I have been able to direct your attention to one fact of interest in our beautiful study, I am happy. I make my salam, and withdraw, content.

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